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In This Issue

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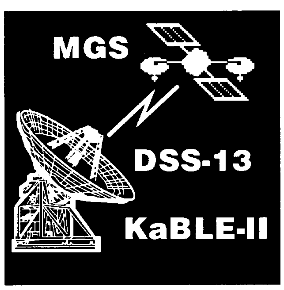
This issue continues to include both Deep Space Network (DSN) science and technology articles. The technology articles are "Mars Global Surveyor Ka-band Link Experiment-II (MGS/KaBLE-II)" by Stan Butman, "Surfsat-1" by Robert Clauss, and "Ka-band Printed Microstrip Reflectarray Antenna" by John Huang and Ronald Pogorzelski. Sami Asmar contributed the science article, "Through the Solar Wind: The DSN Measures Electron Density Outside the Ecliptic Plane."

The MGS spacecraft is now in testing at Cape Canaveral, Florida in preparation for the November 1996 launch to Mars. Stan Butman describes the Ka-bands experiment on MGS and the importance of Ka-band to the improvment of spacecraft-to-ground link performance that will result in lower costs for future missions.

The Surfsat-1 experimental satellite is now in earth orbit, transmitting at X- and Ka-bands. Signals in these bands are tracked using the DSN Goldstone research antenna, six times per week. Bob Clauss describes the Surfsat-1 experiment and the importance of assessing the telecommunications link performance. In addition, prior to the launch of the Japanese VSOP spacecraft Surfsat-1 will transpond at X- and Ku-bands, as a test capability for the DSN's new network of 11m SVLBI ground stations.

New antenna designs are expected to be used with the new smaller and lower costs of deep space missions of the future. John Huang and Ronald Pogorzelski describe the recent design and evaluation of microstrip patch reflectarrays for microspacecraft. The Ka-band reflectarray antenna can be conformally mounted on the spacecraft structure.

The DSN is a world-class instrument for Radio Science research. Sami Asmar describes recent results of probing the solar corona and solar wind outside the ecliptic plane by Ulysses and the DSN. These observations are used to improve the models of the heliographic latitude dependence of electron density in the inner heliosphere.



Mars Global Surveyor Ka-band Link Experiment-II (MGS/KaBLE-II)

Stan Butman

When the Mars Global Surveyor (MGS) spacecraft launches in November 1997, it will carry a flight experiment designed to demonstrate and characterize the performance of Ka-band (32 GHz) deep space communications. The KaBLE-II experiment, sponsored by the Telecommunications and Mission Operations Directorate (TMOD) Technology Program, begins in January 1997 and will be conducted through the end of the MGS mission, past the year 2000.

As shown in Figure 1, both the experimental Ka-band and the operational X-band (8.4 GHz) signals from the spacecraft will be simultaneously received by

***MGS/KaBLE-II* continued from page 1**

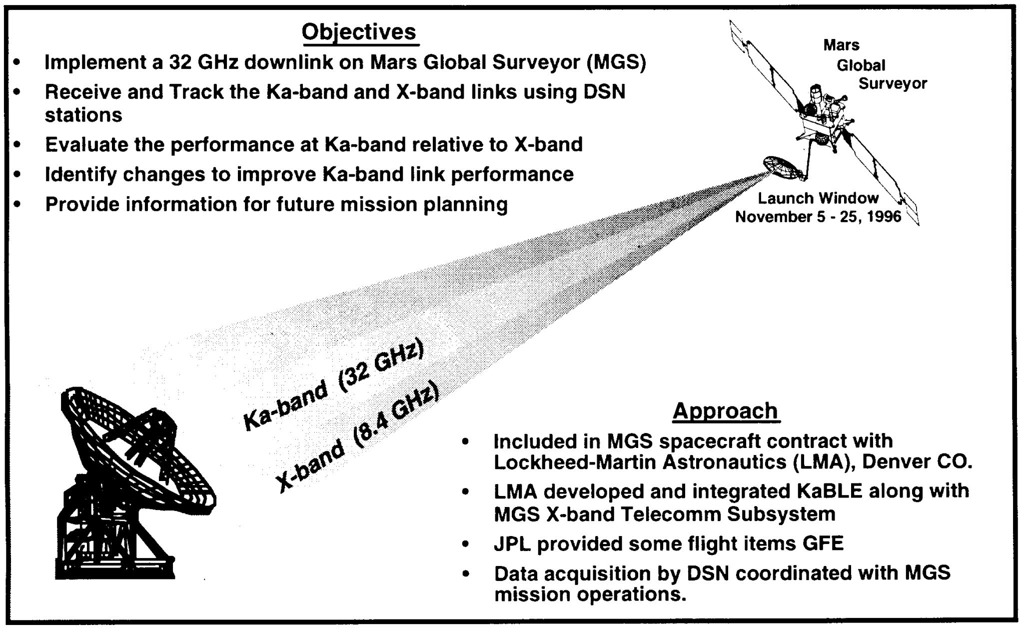


Figure 1. MGS/KaBLE-II Overview

DSS 13, the DSN R&D antenna at Goldstone, California. There, data will be collected on a year-round basis in order to evaluate propagation effects, weather, gravity deformations, and antenna pointing accuracy.

Currently, MGS (Figure 2) is at Cape Canaveral, Florida undergoing final testing in preparation for a November 1996 launch.

Initially, after launch, in the Inner Cruise phase, the spacecraft will be pointed away from Earth and will communicate only via small, wide-beam, X-band patch antennas. In January 1997, as the Outer Cruise phase begins, it will be reoriented to point at Earth and begin communicating at both X-band and Ka-band via its 1.5-m-diameter high gain antenna (HGA). MGS will arrive at and be captured by Mars in September 1997, although mapping will not start until March 1998. It takes that long to lower and circularize the spacecraft orbit by aerobraking.

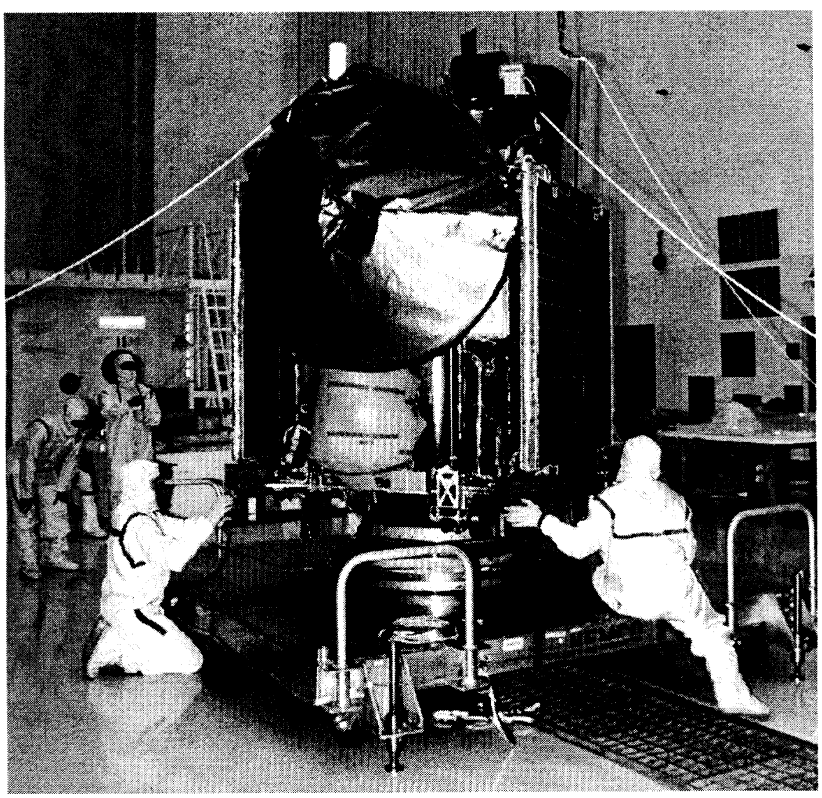


Figure 2. MGS at Cape Canaveral

Perspective

The first deep space mission to use X-band operationally was Voyager, which was launched in 1977. Previously, the Viking, Mariner, and Pioneer missions operated at S-band (2.3 GHz); even earlier missions operated at L-band (960 MHz).

Evolving technology enabled the transition to higher frequencies, gaining a 76-fold increase in data link capacity from L-band to X-band (over and above contributions from larger DSN antennas, ultra-low noise receivers, better coding and modulation, bigger spacecraft antennas, and more spacecraft transmit power).

The gain, as frequency increases, is a result of narrower antenna beams that concentrate more of the transmitted power in the direction of the receiver. The gain for Ka-band relative to X-band would naively be a factor of 14. However, this